


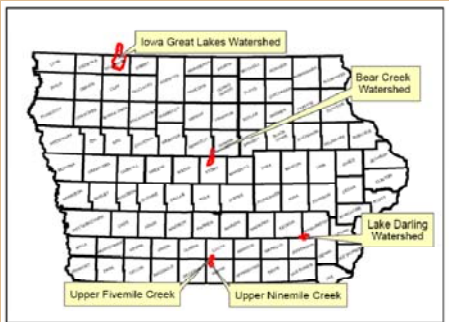
# LiDAR in Iowa


Update 08/08/07

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Iowa Department of Natural Resources  
GIS Section

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Our experience dabbling with Lidar.  
Five watersheds flown in 2005




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## LiDAR in Iowa 2005

- Five watersheds flown in spring 2005
- Over \$1 per acre (including breaklines, "high-accuracy" DEM and 2' resolution color orthophotos)
- 1 meter postings
- 15 cm RMSE vertical accuracy (non-vegetated surfaces)

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This is your brain on NED.....



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This is your brain on Lidar....!



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## LiDAR in Iowa?

- Contract price: \$75-\$85 per sq. mile (11 to 13 cents/acre) for large acquisitions – Iowa = 56,000 sq. miles

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Instead of a \$20 million project for the whole state, it became a \$4 million project



*We can do that!*

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### LiDAR in Iowa!!!

- USGS 2005 CSC-2 contract with Sanborn
  - Productized LiDAR: FEMA, Standard, High-res
  - FEMA and Standard Product Specs:
    - 1.4 m postings
    - 18.5 cm RMS @ 95% confidence
    - 37 cm RMS in vegetation
    - 1 m horizontal RMS @ 95% confidence
    - 95% of vegetation: FEMA product; (90% - Standard product)
    - 90% artifacts: FEMA; (89% - Standard)
    - 95% outliers: FEMA; (90% - Standard)
    - 98% of buildings removed: FEMA Product; (95% - Standard)
  - Deliverables: ASCII x,y,z,i text files; LAS all return binary files

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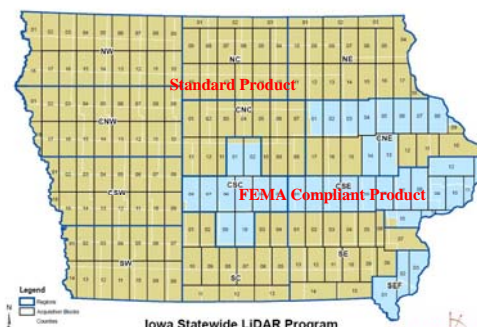


### LiDAR in Iowa!!!

What makes FEMA Product special?

- Groundtruthing is performed
- GPS baseline 20 km (standard product 40km)
- Manual Processing to remove extras:
  - 95% of vegetation
  - 90% of artifacts
  - 95% of outliers
  - 98% of buildings

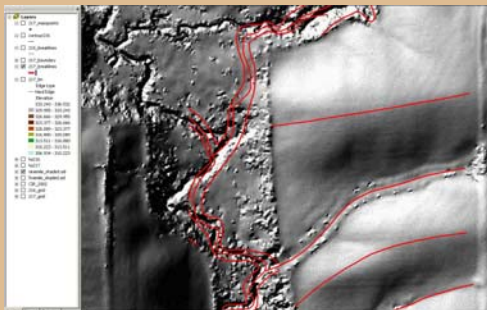
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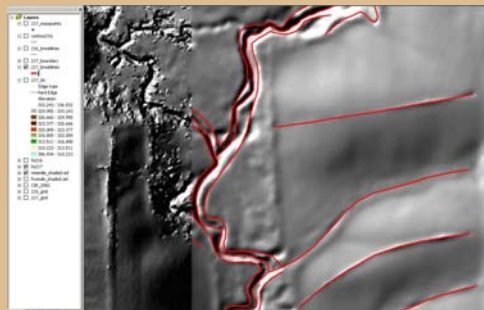
So you want some breaklines, eh?  
Our DEM hillshade plus breaklines from photogrammetry



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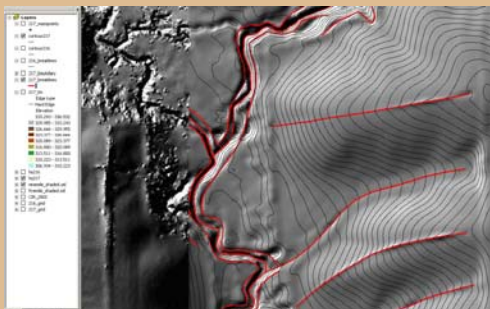
Hillshade made from breakline DEM



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Breakline DEM hillshade and 2' contours



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Funding LiDAR in Iowa?!?

- Iowa Dept. of Transportation - \$1.5M
- Iowa Dept. of Agriculture and Land Stewardship - \$.57M
- Iowa State Office of USDA NRCS - \$1M
- Iowa Dept. of Natural Resources - \$1.23M
- Total \$4.3 M**

*\*Use of State Revolving Loan Fund for Water Quality to make payments easier*

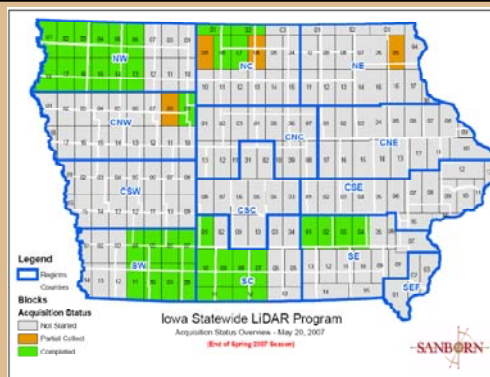
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LiDAR in Iowa!

- Full state Lidar acquisition spread over 2 years
- Lidar products for 19 counties will meet FEMA flood plain mapping guidelines; 80 counties will be standard product
- Acquisition started in fall/winter 2006, continuing spring and fall/winter of 2007, probably finish up in spring 2008
- Avoid leaf-on conditions (May through October)
- Avoid snow and flood waters

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LiDAR in Iowa...

- Delivery starts after a "lot" is completed – may get first lot this fall
- USGS has 60 days to accept product – USGS will provide some QA/QC
- "Raw" data will be free and available to the public via ftp server as soon as possible

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LiDAR Products for Iowa

- Product delivered as 2 x 2 km tiles (36,424 tiles in state!)
- Each tile will have around 1.5 million data points
- Deliverable 1: ASCII text files with BARE EARTH x,y,z,i ~ 2 TB total
- Deliverable 2: binary, LAS format files with all data and returns (first, last, bare earth, intensities, classifications) ~ 3 TB

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### LiDAR USERS in Iowa

- Most users want X,Y,Z data for CAD
  - IDOT and County engineers
  - NRCS and IDALS conservation technicians
  - IDNR land acquisition and engineering
  
- GIS users want various products: DEMs, contours, slopes, shaded relief, structures and vegetation – estimate about 2 years to build DEMs and derived products

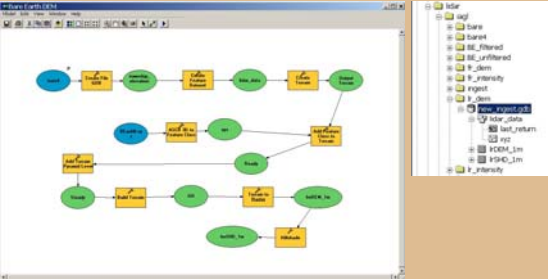
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### Derived GIS products ~ 20 TB



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We estimate that a county size's worth of elevation data set can be built in about a week of processing raw lidar data using terrain models in ArcGIS 9.2 – include BE, FR, LR



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### ArcGIS 9.2 Workflow

- Starts with ASCII x,y,z,i 2x2 km tiles
- Run Python script to create huge x,y,z file from many tiles (if needed, run CORPSCON to change projection and units)
- Run Modelbuilder script to import x,y,z points, build terrain, create DEMs, shaded relief, and contours
- Or run a Modelbuilder script to start with the LAS files, directly extract points, build terrains, DEMs, etc.

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### A County's Worth of Lidar Data

- Estimate there will be about 500-600 million elevation points – these will be processed into:
- An ArcGIS 9.2 terrain feature set in a file geodatabase
- A 1.0 meter bare earth DEM and shaded relief image
- A slope grid from the DEM
- 2' contours from the DEM
- A 1.0 meter first return DEM and shaded relief image
- Calculate first return and bare earth difference to get height of trees and buildings
- First return and bare earth intensity images to record ground conditions at the time of lidar acquisition
- ~50 Gigabytes of storage space needed

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### *How CAD folks might work with lidar data from the statewide project*

- Download ASCII x,y,z,i 2x2 km tiles from ftp server or web application
- Run free CORPSCON program to change projection and format
- Load x,y,z files into CAD program
- Create TINs, grids and contours
- Save lots of time and money
- Boss is happy, give you big raise!

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What's one of the best uses of Lidar elevation data?  
*Mapping really flat land...*



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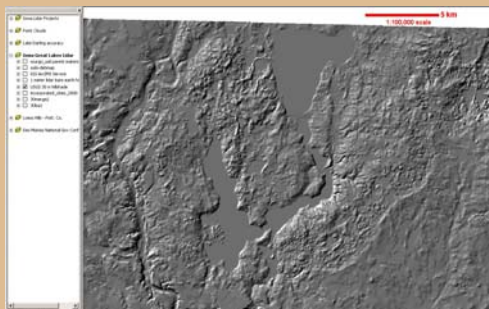
Iowa Great Lakes Lidar Project  
2002 Color-infrared airphoto



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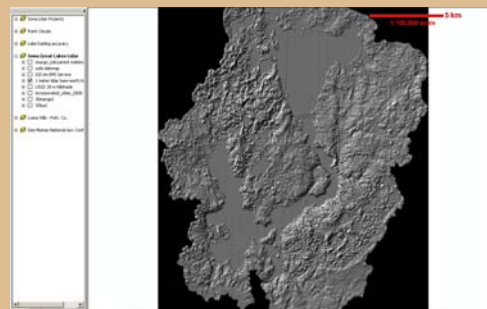
Iowa Great Lakes Lidar Project  
30 meter NED hill shade



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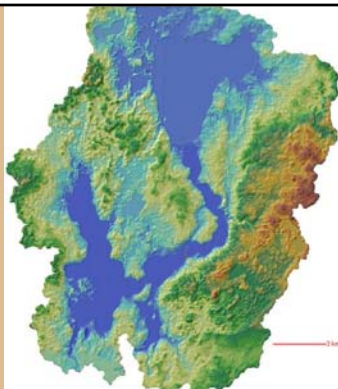
1 meter Lidar DEM hill shade



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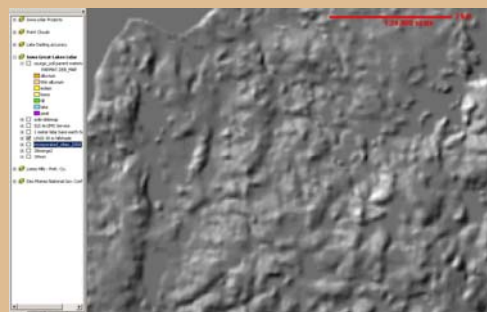
Lidar elevation in  
color over shaded  
relief



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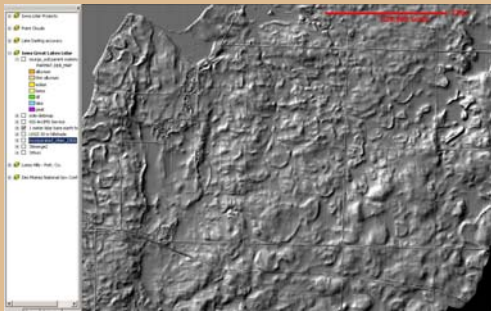
NED hill shade close up at 1:24k




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### Lidar DEM hill shade




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### Ice walled lakes in Siberia




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### Spring Run Wetland Complex



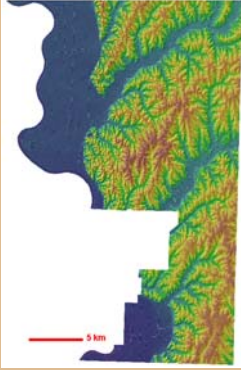
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### A not so flat place in western Iowa – The Loess Hills



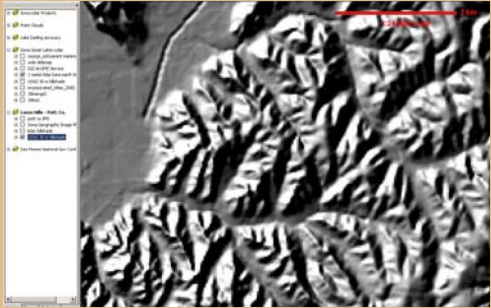
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### Loess Hills: lidar data from Pottawattamie County GIS Department - thanks David Bayer!



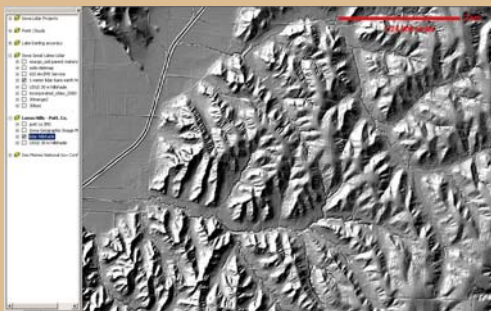
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### 30 meter NED DEM hill shade at 1:24k



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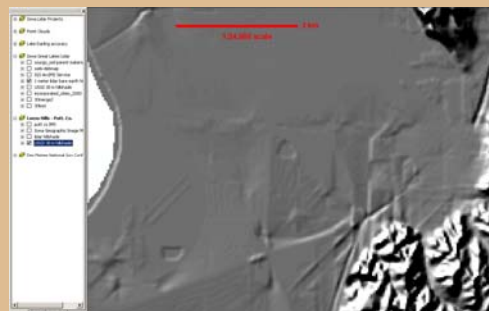
### 8' Lidar DEM hill shade



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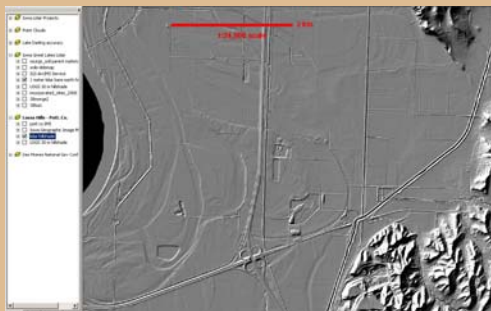
### Missouri River floodplain by NED



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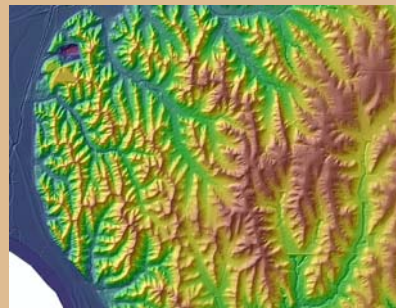
### Missouri River floodplain by Lidar



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### Loess Hills: wind blown silt up to 100' thick



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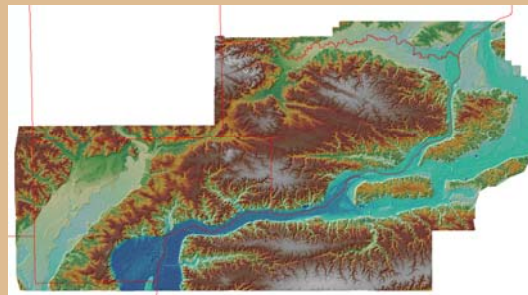
### "Hungry canyons" and mining loess for fill for Omaha and Council Bluffs



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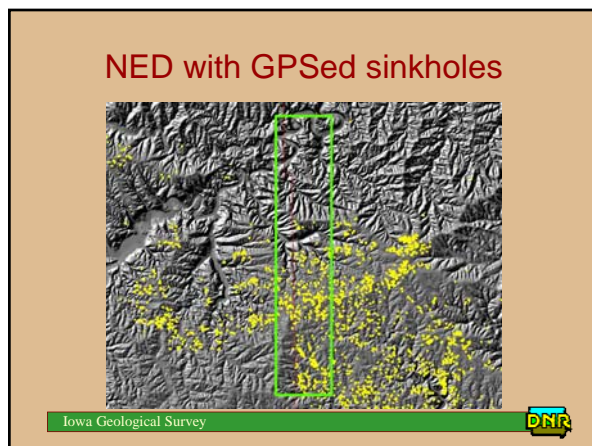
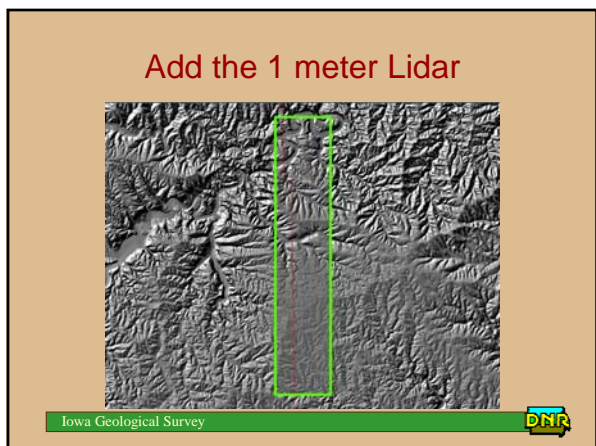
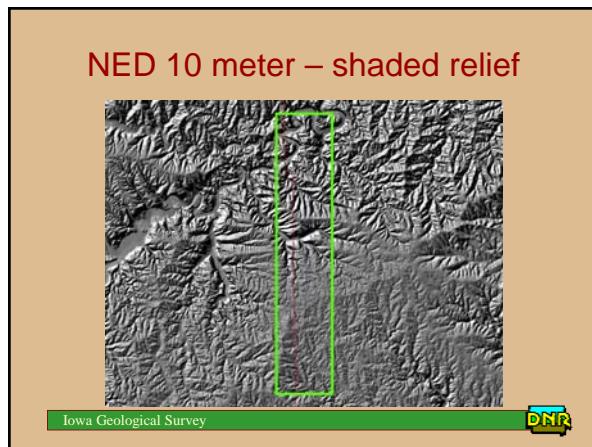
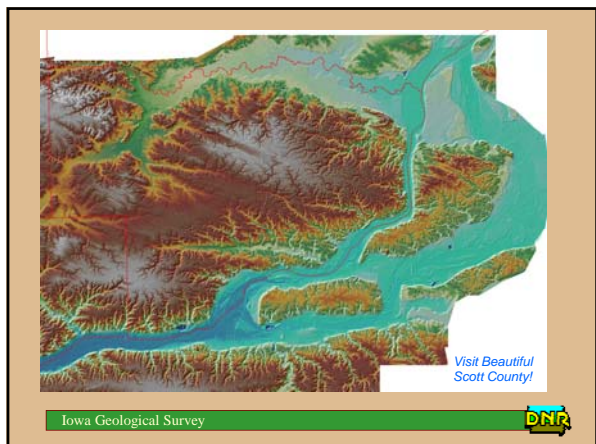


### Scott Co GIS Department lidar data: - thanks Ray Weiser!

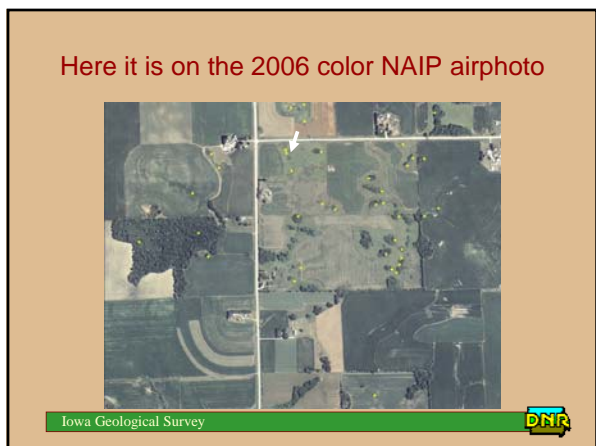
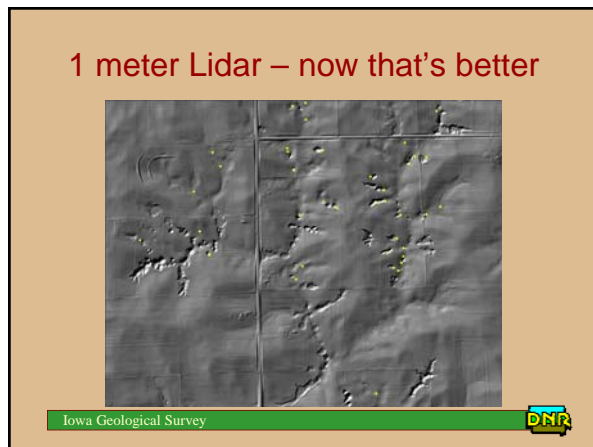
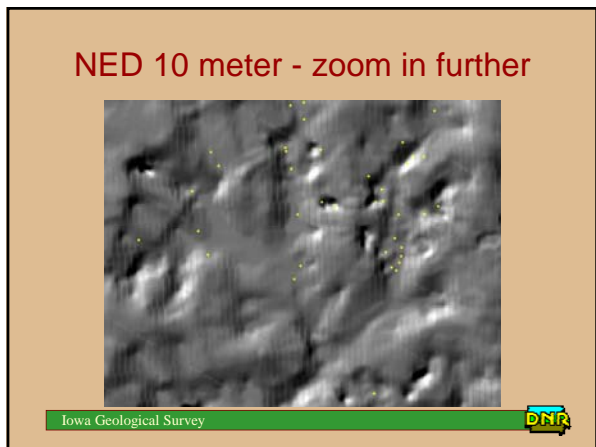
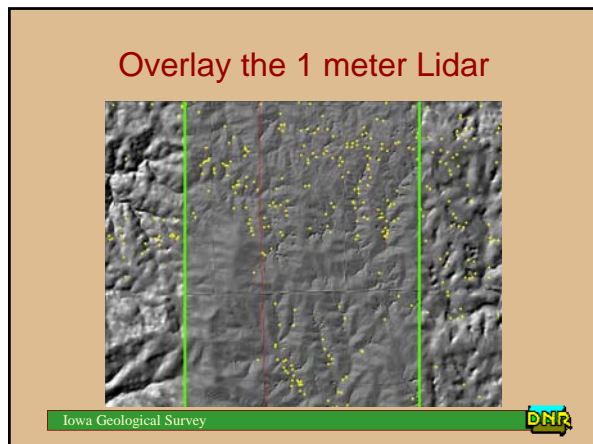
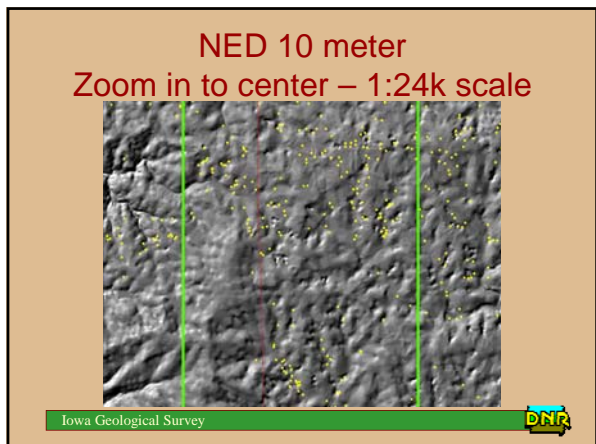


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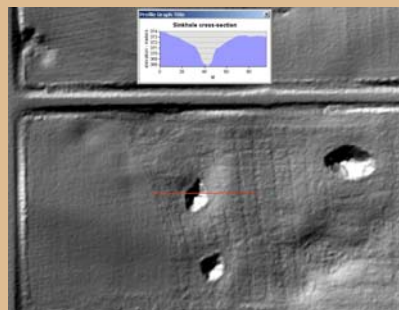
Same sinkhole from the ground



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And this little sinkhole is about 10' deep



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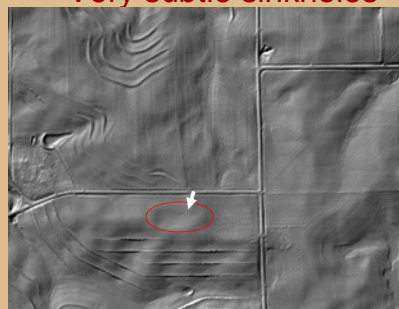
Let's look at another sinkhole area



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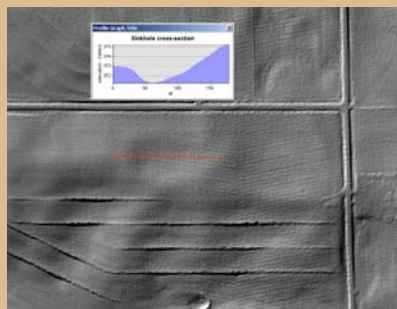
Very subtle sinkholes



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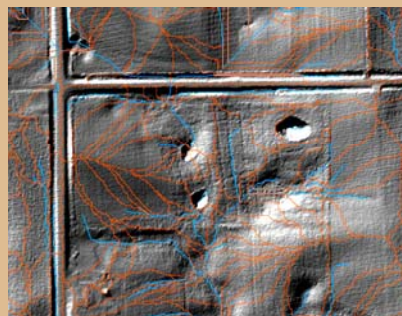
Subtle sinkhole about 6' deep



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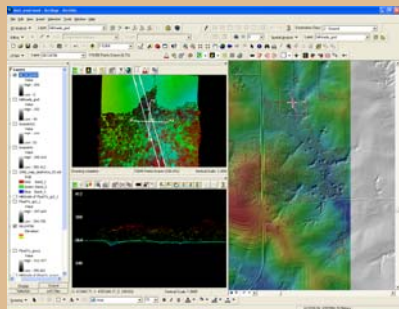
ArchHydro – sinkhole catchments



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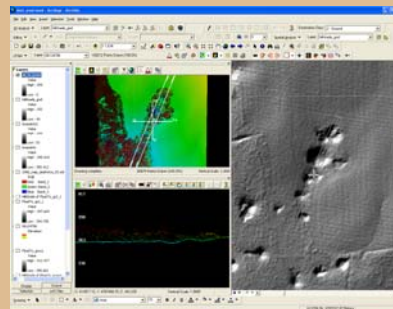
### Using LAS binary data – all returns



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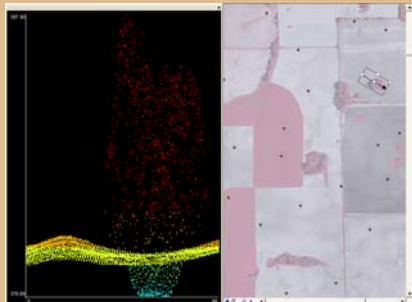
### Trees and sinkholes



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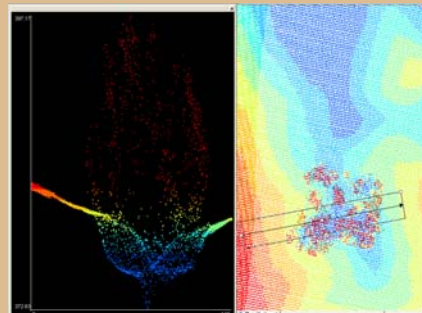
### Trees and sinkholes



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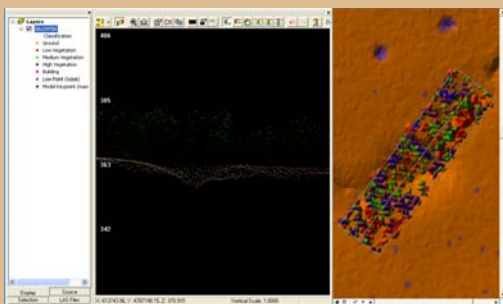
### Trees and ravines



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### Reclassification of LAS Points



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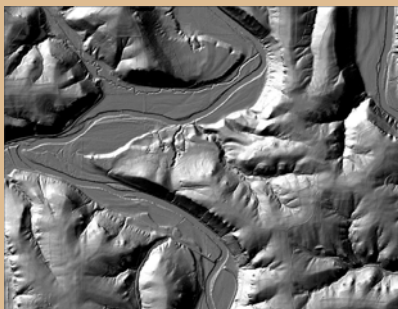
### Once more – NED 10 meter Upper Iowa River valley



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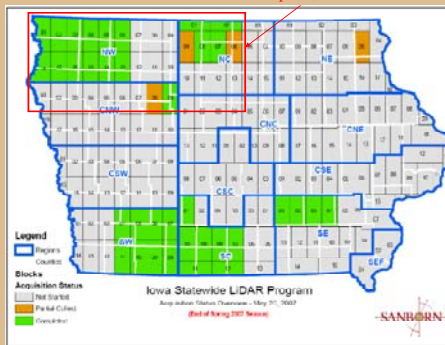
### Lidar - 1 meter



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2' pixel, four-band 1:400' orthoimagery

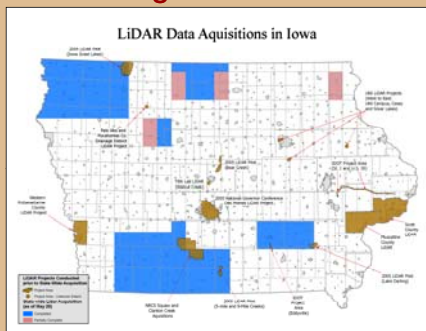


Lyon, Sioux, Osceola, O'Brien, Taylor, Adams, Ringgold, Union, Clarke, Decatur, Mahaska, Keokuk Counties may be in the first delivery - this fall???

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### Enough about us...



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### So now what?



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### Common reactions to this presentation



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### Questions?

#### Answers.....

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